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REPORT OF SURVEY CONDUCTED AT

WAINWRIGHT INDUSTRIES, INC.

ST. PETERS, MO

JUNE 1995

BEST MANUFACTURING PRACTICES



Center of Excellence for Best Manufacturing Practices

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PREFACE



During the week of 26 June 1995, a Best Manufacturing Practices (BMP) survey was conducted at Wainwright Industries, Inc. in St. Peters, Missouri. Wainwright Industries, Inc. is a family-owned business that manufactures stamped and machined parts for automotive, aerospace, home security, and information-processing industries, as well as providing technical services. With annual sales of \$30M, the company employs 275 associates at its 110,000 square foot headquarters and main manufacturing facility in St. Peters, Missouri and at a 190,000 square foot plant in Grand Prairie, Texas.

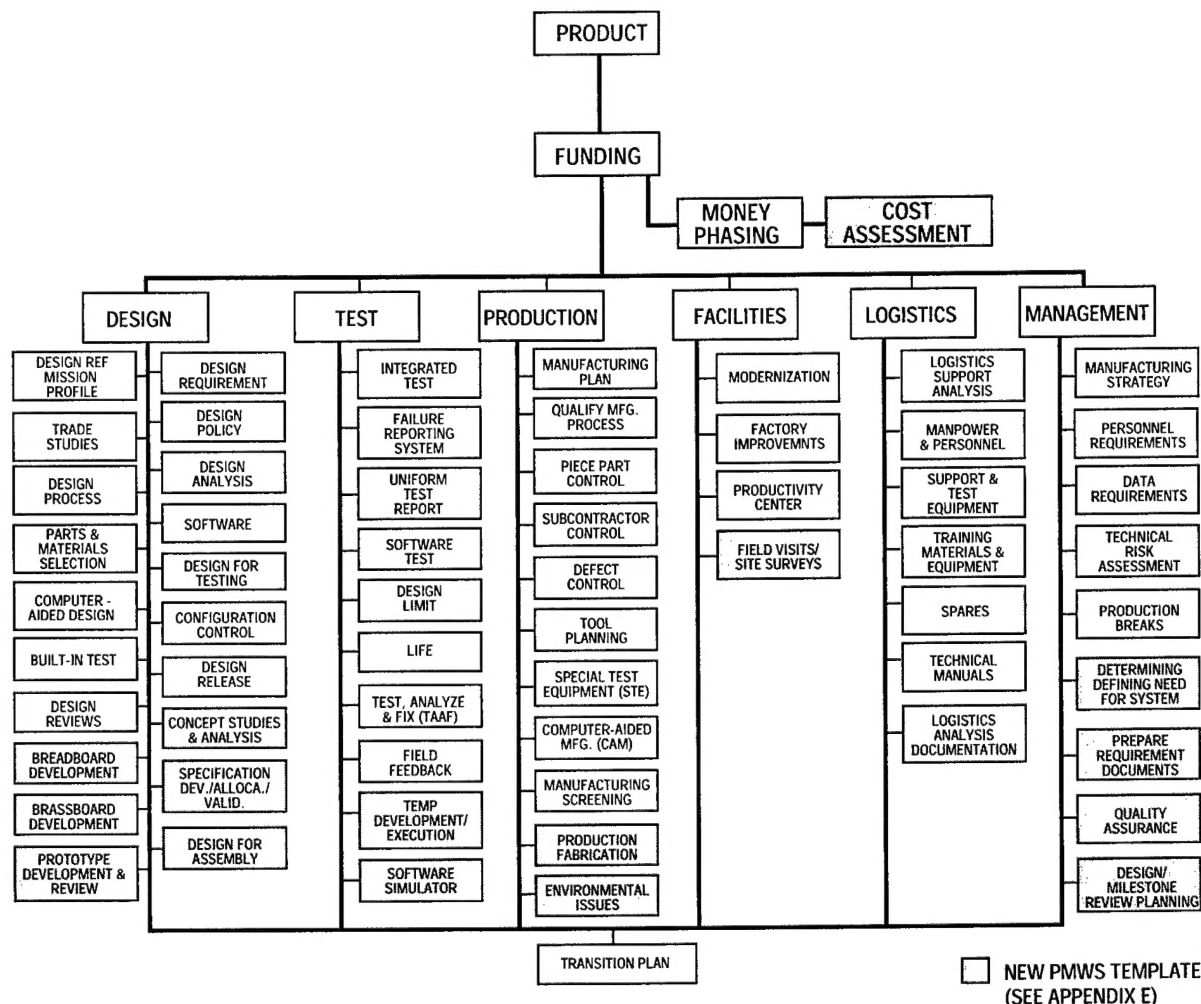
A company commitment to its employees is very strong at Wainwright and is solidly based on the sincere trust and belief in its people. This commitment in turn provides the basis for the company's assertion that any product can be made "best in class" with the right "people" approach. Training and support for the associates constitute a critical aspect of its business, and Wainwright consistently invests up to 7% of payroll toward training and education. Wainwright personnel are properly trained, work in a safe environment, and average 1.25 implemented continuous improvement process suggestions per employee per week. As a result, Wainwright has achieved many awards including the 1994 Malcolm Baldrige National Quality Award.

BMP surveys are conducted to identify best practices in one of the critical path templates of the Department of Defense (DOD) 4245.7-M, "Transition from Development to Production" document. This document provides the basis for BMP surveys that concentrate on areas of design, test, production, facilities, logistics, and management. Practices in these areas and other areas of interest are presented, discussed, reviewed, and documented by a team of government engineers who are invited by the company to evaluate the company's policies, practices, and strategies. Only non-proprietary practices selected by the company are reviewed. In addition to the company's best practices, the BMP survey team also reviews potential industry-wide problems that can be referred to one of the Navy's Manufacturing Technology Centers of Excellence. The results of the BMP surveys are entered into a database for dissemination through a central computer network. The actual exchange of detailed data is between companies at their discretion.

The Best Manufacturing Practices program is committed to strengthening the U.S. industrial base. Improving the use of existing technology, promoting the introduction of enhanced technologies, and providing a non-competitive means to address common problems are critical elements in achieving that goal. This report on Wainwright Industries, Inc. will provide you with information you can use for benchmarking and is part of the national technology transfer effort to enhance the competitiveness of the U.S. industrial base.



“CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION”



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SECTION 1

EXECUTIVE SUMMARY

1.1 BACKGROUND

Wainwright Industries, Inc. is a family-owned business that manufactures stamped and machined parts for automotive, aerospace, home security, and information-processing industries, as well as providing technical services. With annual sales of \$30 million, the company employs 275 associates at its 110,000 square foot headquarters and main manufacturing facility in St. Peters, Missouri and at a 190,000 square foot plant in Grand Prairie, Texas. The metal stamping and assembly division provides a broad range of high-volume, close-tolerance metal stampings and assemblies shipped throughout the United States, Canada, and Mexico. The highest-volume product line consists of deep drawn housings for electric motors used on power windows, antilock brakes, power seats and windshield wipers. The CNC machining division specializes in machining complex, multi-contour parts for the commercial and military aircraft industries. Technical services provided include computer model file maintenance and programming using a Unigraphics CAD system. In addition, product sequencing is provided for automotive assembly centers. Sequencing services include inventory management, sub-assembly of components, and just-in-time shipping.

"People are our most important asset" is a phrase frequently touted by companies and corporations during BMP surveys. However, at few other facilities has the commitment been based more solidly in the sincere *trust* and *belief* in its people than at Wainwright Industries. This commitment in turn provides the basis for the company's assertion that any product can be made "best in class" with the right "people" approach. The company is also committed to long-term improvements instead of looking for quick gains. Because training and support for the associates is a critical aspect of its business, Wainwright consistently invests up to seven percent of payroll toward training and education.

The dedication of these assets helps ensure that Wainwright personnel are properly trained, work in a safe environment, and are dutifully rewarded for the significant number of implemented, employee-recommended process enhancement changes. This company averages an impressive *1.25 implemented suggestions per associate per week*.

The significant emphasis on employee value, involvement, and training have produced significant returns and benefits for the company. Wainwright has achieved many awards including General Motor's Mark of Excellence Award, Ford Motor Company's Q-1 Preferred Supplier

Award, McDonnell Douglas bronze level supplier certification, and the Missouri Quality Award in 1993. These awards were complemented in 1994 when Wainwright Industries, Inc. was presented the Malcolm Baldrige National Quality Award.

1.2 BEST PRACTICES

The following best practices were identified at Wainwright Industries.

Item	Page
Unigraphics Profit Center	3
Wainwright's Unigraphics Profit Center has become a successful business unit that resulted from a 1985 strategic investment decision to procure the Unigraphics system to develop machining packages for its CNC machines.	
Deep Draw Metal Stamping	3
Wainwright's deep draw stamping process for motor housing production has been successfully reengineered and refined since 1985.	
Vendor Certification Process	4
Wainwright's Vendor Certification Process ensures that a supplier has the capabilities to provide quality products and services on time and within the agreed price.	
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Wainwright has a Mission Control Room which is the center for all continuous improvement efforts.	
External Customer Satisfaction Index	5
Wainwright Industries' External Customer Satisfaction Index survey process produces a key performance indicator to measure how effective the company is to its external customers in communication, delivery, quality, and responsiveness.	
Customer Service Department	5
The Customer Service Department is a quick response team that prepares quotes, takes orders, provides job status, processes order changes, and addresses customer concerns in an efficient, highly successful effort.	

Item	Page	Item	Page
Associate Empowerment	6	program but a <i>process</i> that includes on-going training, safe work practices, properly guarded machinery, clean facilities, teamwork, and management support.	
Wainwright believes that people are more important than any manufacturing process, and that all products can be produced as best-in-class with the right "people" approach. Further, Wainwright empowers its personnel by giving them the tools and capabilities needed to improve any process.		Continuous Improvement Process	7
Internal Customer Satisfaction Index	6	The Continuous Improvement Process is followed by all associates for submitting, processing, and implementing suggestions and defining awards. The system emphasizes the application of soft technology, 100% participation by the associates, and 1.25 suggestions implemented per employee per week.	
The Internal Customer Satisfaction Index survey process produces the same key performance indicators as its External Customer Satisfaction Index counterpart and measures the effectiveness within and between Wainwright departments in communication, delivery, quality, and responsiveness.		1.3 POINT OF CONTACT	
Training	6	For any information regarding items in this report, please contact:	
Training is an integral part of business at Wainwright Industries, and the company budgets up to 7% of its annual payroll (an average of 2.8 hours per week) toward training its associates and managers.		Ms. Jo Sanders Customer Service Manager Wainwright Industries, Inc. 17 Cermak Blvd. P.O. Box 640 St. Peters, MO 63376 314-278-5850 FAX: 314-278-8806 or 314-278-8072	
Safety First	7		
A safe environment is the first and most important priority at Wainwright Industries. Safety is not a			

SECTION 2

BEST PRACTICES

2.1 DESIGN

COMPUTER-AIDED DESIGN

Unigraphics Profit Center

Wainwright's Unigraphics Profit Center has evolved as a successful stand-alone unit that conducts business with outside customers. This Center resulted from a 1985 strategic investment decision to procure the Unigraphics system to develop machining packages for its CNC machines. Originally purchased because of its powerful solids modeling software, analysis tools, and capability to do complex work, the Unigraphics system was also chosen by a Wainwright customer as its standard design tool. This factor would allow easy file transfer between the two companies. Because yet another customer was having difficulty using the Unigraphics system, Wainwright began helping the company to properly use the system. As this relationship progressed, Wainwright was contracted to do Unigraphics work for that customer, and the outside work on the Unigraphics system now accounts for 80% to 90% of the Center's total work.

The Unigraphics Profit Center has prospered because of Wainwright's expertise on the system, but other factors have also played important roles in the growth. The company maintains a strong philosophy in sharing information and expertise. Although sharing of what it knows with its customers led to this initial work for others, Wainwright

also believes that there should be direct dealing with the end customer on any technical issues. Potential problems are identified, the customer is contacted and then consulted on whether the problem should be corrected.

Also, Wainwright asserts that from its perspective, relationships with its customers and suppliers are based on trust, respect, and good communication. In support of those relationships, the company expends significant effort on sharing knowledge and expertise with both. And just as Wainwright addresses its suppliers based on these important qualities, it is working with its customers to cultivate a similar environment where Wainwright's position towards suppliers is paralleled from the customer's perspective. This critical balance of two-way trust, respect, and communication is the principal reason behind the success of the Unigraphics Profit Center as well as the success of Wainwright as a business.

2.2 PRODUCTION

PRODUCTION FABRICATION

Deep Draw Metal Stamping

Wainwright's deep draw stamping process for motor housing production has been successfully reengineered and refined since 1985 (Figure 2-1). This process uses progressive tooling and requires two 400-ton presses and one 600-ton press for

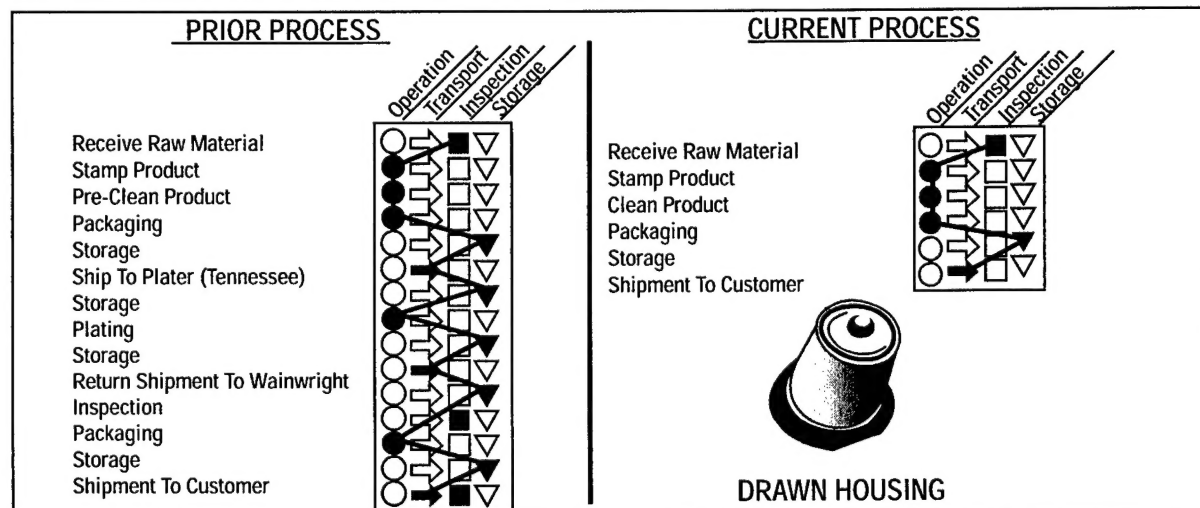


FIGURE 2-1. SYNCHRONOUS ORGANIZATION CONTINUOUS IMPROVEMENT PROCESS

different motor housings. The capability to make the deep drawn housings using progressive tooling provides a significant cost advantage over Wainwright's competition.

Examples of process enhancements include using a pre-coated material instead of plating the part after stamping. This had led to significant savings in lead time since the part does not have to be sent out for plating. The cleaning process has been improved with the addition of rust inhibitors in the cleaning solution to increase the parts' shelf lives. The process has also been improved by performing the pre-rinse and the media tumbling in-line with the press, instead of in an off-line operation. Using the pre-coated material instead of plating afterwards has resulted in a 35% cost reduction that was passed on to the customer. Production lead time was also reduced from 8.75 days to 15 minutes.

The motor housing production rate is currently 425,000 parts per week of 10 different part numbers. In-die sensors have been installed for three part numbers, with more planned in the near future. The sensors detect the absence of any portion of the tool at each operation. The press can then be stopped before damage is done to the die by a portion of a broken tool progressing to the next stage of the process. In the six months since the sensors have been installed, ten instances of potential serious die damage have been averted. Returnable packaging material is recycled by Wainwright customers and is used on 225,000 housings per week. Additional housings will be shipped using the returnable packaging in the future as more customers agree to accept the new packaging.

2.3 MANAGEMENT

MANUFACTURING STRATEGY

Vendor Certification Process

Wainwright's Vendor Certification Process ensures that a supplier has the capabilities to provide quality products

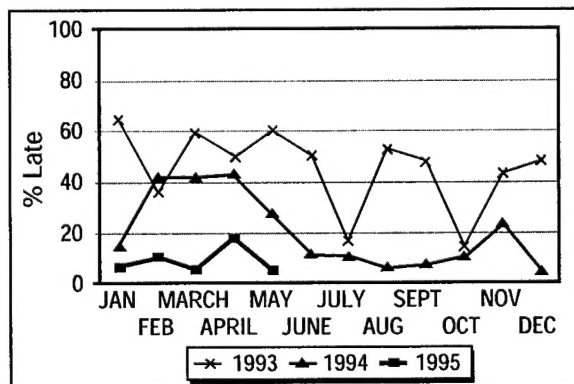


FIGURE 2-2. RAW MATERIAL (% LATE)

and services on time and within the agreed price. The process also provides a method for measuring and providing feedback to the supplier through pre-survey questionnaires, on-site reviews, and delivery-rating and discrepant-material reports. This process helps Wainwright maintain acceptable quality standards and capabilities within its supplier base.

The Vendor Certification Process consists of two key elements – a pre-survey evaluation report completed by the vendor and a survey evaluation report completed by a Wainwright evaluator through an on-site review. The on-site review captures firsthand testimony and validates the survey results. A point scoring system is applied to the survey results that ranks the vendor's conformance in the following categories: general (quality) systems, statistical process control, drawing and specification control, measurement and test equipment control, subcontracted supplies and services control, nonconforming materials control, and final inspection/audit. An internally developed standard survey form is used to collect the data and calculate the scoring results as a percentage. The process rates vendors as Approved, Preferred, or Certified, the latter being the highest level. A score of 50% or more classifies a company as an Approved Vendor, 70% or more as a Preferred Vendor, and 65% or more with a score of two or better on each question as a Certified Vendor. Additionally, the process feeds back to the vendor information on its strengths and opportunities associated with each section.

Approximately 45 vendors supply over 50% of the materials required by Wainwright based on purchase cost. These vendors are the focus of the Vendor Certification Process, with an additional 12-15 vendors targeted for future certification. Since 1993 when the program was initiated, 41 vendors have achieved Approved ratings, one has achieved the Preferred rating, and four are at the Certified level. Wainwright strives to bring the Approved and the Preferred vendors to the Certified level.

Under this Vendor Certification Process, raw material delivery dates have improved from an average of 50% late deliveries in mid-1993 to less than 10% in mid-1995 (Figure 2-2). On-time deliveries have contributed to steel inventory levels decreasing from 2.3 million pounds to 1.15 million pounds (Figure 2-3). Rejection rates have also been reduced from 30% in 1993 to 10% in 1995.

Mission Control Room

Wainwright has a Mission Control Room which is the center for all continuous improvement efforts. Quality trends and performance indicators are displayed as well as monthly customer satisfaction index scores. Training sessions, staff meetings, and presentations to customers and suppliers are held in the Mission Control Room to keep the

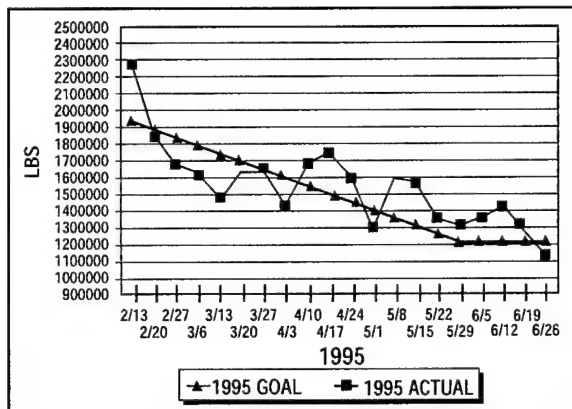


FIGURE 2-3. STEEL INVENTORY LEVELS

indicators visible. A green flag/red flag system is used to illustrate if Wainwright is on track to meet customer goals, and a green flag indicates that the company is on track. A red flag indicates a problem. If a red flag is displayed, an action team is formed to work with the customer, study the problem, and identify and implement corrective action. A customer champion is assigned for each customer.

Five key indicators, ranked according to priority, are tracked and include safety, internal customer satisfaction, external customer satisfaction, six sigma quality, and business performance. The priority was determined based on a survey of the associates and what was important to them. The order was exactly opposite from the company's previous order. By accepting the results of the associate's survey, management was demonstrating the importance it places on the employees. The company had trust in the associates and acted on that trust to change the way Wainwright approached its business.

By highlighting the five key indicators and applying corrective actions to any problems, on-time delivery rates are approaching 100%, and there has been a 35% reduction in product cost. Overall customer satisfaction has improved to 97.5% with a goal for 1995 of 98%. Process re-engineering and simplification have resulted in the lead time for one product decreasing from 8.75 days to 15 minutes, while decreasing defect rates by a factor of ten.

External Customer Satisfaction Index

Wainwright Industries' External Customer Satisfaction Index survey process produces a key performance indicator to measure how effective the company is to its external customers in communication, delivery, quality, and responsiveness. The index creates a customer focus and enhances quality performance towards the outside customer, defined as a person or company that receives products or services from Wainwright Industries (the supplier).

Wainwright has developed guidelines for this process and uses it with all external customers. Performance data that includes a rating on the level of customer satisfaction toward supplier communication, delivery, quality, and responsiveness is collected from the customer on an evaluation form. The Customer Service Department distributes the evaluation forms to customers, collects the forms and comments, calculates the scores, enters the data in a database, and provides a copy to the Customer Champion. The forms are sent every month to any customer who represents at least 0.5% of the company total sales. Other customers are sent an evaluation form on an as-shipped basis. Each month, customers phone, fax, or mail in their grades. Any score below 95% results in the Customer Champion assembling a cross-functional team which develops an action plan within 48 hours. Customer scores and comments are posted in Wainwright's Mission Control Room for visibility to associates and management.

The External Customer Satisfaction Index survey process provides a sound vehicle for measuring Wainwright's effectiveness toward its external customers. Scores have increased from 84% in 1992 to 97.5% currently. A 98% rating is the goal for 1995.

Customer Service Department

The Customer Service Department provides all interface between Wainwright Industries and its customers. The Department is a quick response team that prepares quotes, takes orders, provides job status, processes order changes, and addresses customer concerns in an efficient, highly successful effort. External Customer Satisfaction Index surveys are also administered by the Customer Service Department and sent to all customers representing at least 0.5% of Wainwright sales.

At Wainwright Industries, the Customer Service Department has a staff of five cross-trained personnel who provide a quick and efficient response to all the Wainwright customers. This consolidation eliminates the need for customers to navigate through a company's organization to identify the appropriate point of contact and acquire the information needed. The team closely coordinates customer interface with the internal resources of the company. Team personnel attend weekly meetings with Production Control for project updates and to maintain a status record of each job including shipping dates, quantities, and schedule. The team coordinates the routing of purchase orders and relative documents with Production Control and assembles individual job folders that include copies of quote work sheets, formal quotes, latest drawings, and the purchase order. The team, company president, quality assurance, project coordinator, plant manager, design manager, and production manager then attend feasibility meetings to address each new job.

The practice of providing a quick response Customer Service Department has proven highly satisfactory to the Wainwright customers. The collocation and cross-training of the staff personnel have contributed significantly to a most efficient and effective operation.

PERSONNEL REQUIREMENTS

Associate Empowerment

Wainwright believes that people are more important than any manufacturing process, and that all products can be produced as best-in-class with the right "people" approach. Further, Wainwright empowers its personnel by giving them the tools and capabilities needed to improve any process.

The first step at Wainwright in empowering its associates is based on a sincere trust and belief in its people. Training and support represent the second most important aspect, and Wainwright routinely spends up to 7% of its payroll on training. The suggestion system is the third empowerment step at Wainwright and is administered by the associates in order to properly solicit and implement associate ideas of the associates. The company encourages the identification and implementation of small issues directly related to the associate's job. Larger ideas then surface even if associates are concentrating on the smaller issues. The fourth step is the Internal Customer Satisfaction Index. Each internal supplier is graded quarterly on performance with an A, B, C, and D grading scale. This allows the early identification and correction of problems. Each manager at Wainwright is also graded on an A, B, C, and D grading scale by the associates on how well he/she is facilitating the associates' ability to do their jobs.

Wainwright has found that to empower the associates, middle managers must be firmly committed to the program because middle management is the key to the success or failure of change. All personnel wear the same uniform with a *Team Wainwright* patch, eliminating the normal management/worker distinctions. All personnel are also paid on a salary basis. These efforts have produced a strong team spirit, and the improvements have culminated in many quality awards, including the 1994 Malcolm Baldrige National Quality Award.

Internal Customer Satisfaction Index

The Internal Customer Satisfaction Index survey process produces the same key performance indicators as its External Customer Satisfaction Index counterpart and measures the effectiveness within and between Wainwright departments in communication, delivery, quality, and responsiveness. As with the external survey, the

internal index creates a customer focus and quality performance on the internal customer. In this case, an internal customer is defined as the associate or department that receives a product or service, while the supplier is the associate or department that supplies a product or service to other associates or departments.

The Internal Customer Satisfaction Index survey processes is applied to all Wainwright associates. Survey data is collected on an evaluation form to provide a level of customer satisfaction in supplier communication, delivery, quality, and responsiveness. A facilitator is assigned to distribute the forms to internal customers, collect the forms and comments, calculate the scores, and distribute them to the suppliers. Ratings below a perfect score of total customer satisfaction become an issue that requires action. Associates, managers, and supervisors create action plans, and strive to meet goals of 100% customer satisfaction.

The Internal Customer Satisfaction Index survey process provides a sound vehicle for measuring the effectiveness of the internal supplier, focusing on the issues, and helping to prioritize actions.

Training

Training is an integral part of business at Wainwright Industries, and the company budgets up to 7% of its annual payroll (an average of 2.8 hours per week) toward training its associates and managers. Training programs have been tailored to incorporate the company philosophy; classes are administered internally with most classes taught on site.

As new processes come on line, associates and managers receive training to understand and perform these new processes. The employees also drive the need for classes to improve work skills. For example, classes are arranged if refresher courses in basic skills such as math, writing, or reading are required. The same situation applies to training in machining operations, SPC, or equipment maintenance. Considerable training focuses on safety, teaming, problem solving, and human behavior – areas that affect the internal customer. Examples include *Being a Team Player*, *Requesting Help*, *Taking on a New Assignment*, *Keeping Your Boss Informed*, *Resolving Issues with Others*, and *Dealing with Emotional Behavior*. Training classes administered by Wainwright are also complemented with a tuition reimbursement program that allows associates and managers to attend off-site classes at other learning institutions.

Training helps develop self-confidence and self-recognition at Wainwright, and its effectiveness is measured through improvements in quality and operational performance, and through associate promotion percentage. Currently, 60% of all Wainwright associates have been promoted at least once.

Safety First

A safe environment is the first and most important priority at Wainwright Industries. Safety is not a program but a *process* that includes good training, safe work practices, properly guarded machinery, clean facilities, teamwork, and management support. Every aspect of the Wainwright Industries business has benefited from this emphasis on safety. In 1991, Wainwright Industries prioritized safety – identified as the most important concern of its associates – as the first and most important measurement category, ahead of internal customer satisfaction, external customer satisfaction, quality, and business performance.

Several factors contribute to the safety process at Wainwright. For example, up to 7% of its annual payroll is spent on training, with substantial emphasis placed on safety. New associates receive a one-day orientation on company safety. They are then required to work at least two weeks with the trainer and a longtime associate learning to safely and correctly perform their jobs before being released to work alone. Refresher courses on safety-related issues are also conducted. Safety suggestions are encouraged through the company's Continuous Improvement Process suggestion program. Every day, each area of the facility is randomly checked and graded on housekeeping, safety, and organization. A failure in any of these areas requires a Continuous Improvement Process to improve the situation. A World Class Safety Committee helps associates prioritize safety goals, is responsible for conducting safety investigations, and acts as liaison between management and associates on safety issues. Video reenactments made by the associates and the World Class Safety Team are made to evaluate circumstances that could lead to an accident or resulted from an accident. The circumstances around the accident are then used in corrective actions and safety training to ensure similar accidents will be avoided. Safety expenditures are not subject to the same scrutiny as other requests. Each job coming on line is reviewed for safety, from receipt of incoming material to shipping the parts, with the same detail as given to the design, fabrication, and test requirements.

The safety-first priority has benefited every aspect of the Wainwright business. Associates have a high degree of certainty that they will be injury-free. Since 1991, workers' compensation claims have dropped to zero. The number of accidents per year are nearing zero. Lost time due to

accidents has decreased by 85% resulting in an attendance rate that is up to 99%. Customer satisfaction ratings are at 95% and continue to improve.

QUALITY ASSURANCE

Continuous Improvement Process

The Continuous Improvement Process (CIP) at Wainwright is followed by all associates for submitting, processing, and implementing suggestions and defining awards. The Continuous Improvement Process suggestion system emphasizes an ongoing flow of ideas from associates and emphasizes the application of soft technology, 100% participation by the associates, and 1.25 suggestions implemented per associate per week.

A Continuous Improvement Process suggestion can be any associate's idea which has potential to improve an area of the work place. The associate determines the opportunity, proposes a solution, submits a completed CIP form to the supervisor, and consults with the supervisor for assistance whenever necessary. Each associate has primary responsibility for submitting, completing, and verifying completion of the CIP suggestion. The form is completed only after the suggestion has been implemented.

Recognition and awards are based on ideas that have been implemented. Each completed CIP counts as one credit; however, safety CIPs count as three credits toward recognition and awards. Cost savings and benefits analysis are reviewed but not overly-scrutinized to avoid stalling the process. Associates are not negatively affected on reviews for a lack of CIP participation, although enthusiastic participation indicates promotability and leadership qualities. Recognition is based on the number of credits accumulated from CIPs completed during a specified period. Awards are made to associates and departments through quarterly lunches, random weekly drawings, departmental bi-weekly drawings, and an annual grand prize drawing.

Since CIP implementation in 1991, savings have increased by a factor of ten with annualized cost reduction averaging 5.8% of sales. The number of CIPs completed per associate per week has increased to 1.25, which translates to an average of 65 implemented suggestions from each associate per year.

APPENDIX A

TABLE OF ACRONYMS

ACRONYM	DEFINITION
BMP	Best Manufacturing Practices
CIP	Continuous Improvement Process

APPENDIX B

BMP SURVEY TEAM

TEAM MEMBER	ACTIVITY	FUNCTION
Larry Robertson (812) 854-5336	Crane Division Naval Surface Warfare Center Crane, IN	Team Chairman
Larry Halbig (317) 353-3838	Naval Air Warfare Center Aircraft Division - Indianapolis Indianapolis, IN	

APPENDIX C

PROGRAM MANAGER'S WORKSTATION

The Program Manager's Workstation (PMWS) is a series of expert systems that provides the user with knowledge, insight, and experience on how to manage a program, address technical risk management, and find solutions that industry leaders are using to reduce technical risk and improve quality and productivity. This system is divided into four main components; KNOW-HOW, Technical Risk Identification and Mitigation System (TRIMS), BMP Database, and Best Manufacturing Practices Network (BMPnet).

- **KNOW-HOW** is an intelligent, automated method that turns "Handbooks" into expert systems, or digitized text. It provides rapid access to information in existing handbooks including Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), MIL-STD-2167/2168, SecNav 5000.2A and the DoD 5000 series documents.

- **TRIMS** is based on DoD 4245.7-M (the transition templates), NAVSO P-6071 and DoD 5000 event oriented acquisition. It identifies and ranks the high risk areas in a program. TRIMS conducts a full range of risk assessments throughout the acquisition process so corrective action can be initiated before risks develop into problems. It also tracks key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities in the development and acquisition process.

- The **BMP Database** draws information from industry, government, and the academic communities to include documented and proven best practices in design, test, production, facilities, management, and logistics.

Each practice in the database has been observed and verified by a team of experienced government engineers. All information gathered from BMP surveys is included in the BMP Database, including this survey report.

- **BMPnet** provides communication between all PMWS users. Features include downloading of all programs, E-mail, file transfer, help "lines", Special Interest Groups (SIGs), electronic conference rooms and much

more. Through BMPnet, IBM or compatible PC's and Macintosh computers can run all PMWS programs.

- To access **BMPnet** efficiently, users need a special modem program. This program can be obtained by calling the BMPnet using a VT-100/200 terminal emulator set to 8,N,1. Dial (703) 538-7697 for 2400 baud modems and (703) 538-7267 for 9600 baud and 14.4 kb. When asked for a

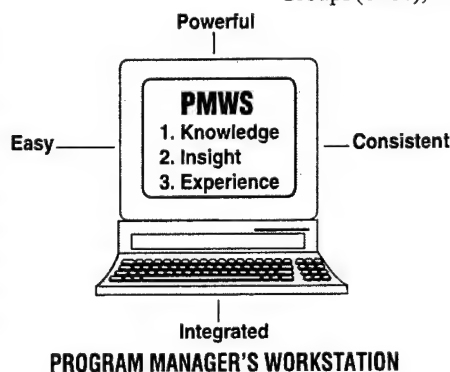
user profile, type: DOWNPC or DOWNMAC <return> as appropriate. This will automatically start the Download of our special modem program. You can then call back using this program and access all BMPnet functions. The General User account is:

USER PROFILE: BMPNET

USER I.D.: BMP

Password: BMPNET

If you desire your own personal account (so that you may receive E-Mail), just E-Mail a request to either Ernie Renner (BMP Director) or Brian Willoughby (CSC Program Manager). If you encounter problems please call (703) 538-7253.



APPENDIX D

NAVY CENTERS OF EXCELLENCE

Automated Manufacturing Research Facility (301) 975-3414

The Automated Manufacturing Research Facility (AMRF) – a National Center of Excellence – is a research test bed at the National Institute of Standards and Technology located in Gaithersburg, Maryland. The AMRF produces technical results and transfers them to the Navy and industry to solve problems of automated manufacturing. The AMRF supports the technical work required for developing industry standards for automated manufacturing. It is a common ground where industry, academia, and government work together to address pressing national needs for increased quality, greater flexibility, reduced costs, and shorter manufacturing cycle times. These needs drive the adoption of new computer-integrated manufacturing technology in both civilian and defense sectors. The AMRF is meeting the challenge of integrating these technologies into practical, working manufacturing systems.

Electronics Manufacturing Productivity Facility (317) 226-5607

Located in Indianapolis, Indiana, the Electronics Manufacturing Productivity Facility (EMPF) is a National Center of Excellence established to advance state-of-the-art electronics and to increase productivity in electronics manufacturing. The EMPF works with industry, academia, and government to identify, develop, transfer, and implement innovative electronics manufacturing technologies, processes, and practices. The EMPF conducts applied research, development, and proof-of-concept electronics manufacturing and design technologies, processes, and practices. It also seeks to improve education and training curricula, instruction, and necessary delivery methods. In addition, the EMPF is striving to identify, implement, and promote new electronics manufacturing technologies, processes, materials, and practices that will eliminate or reduce damage to the environment.

National Center for Excellence in Metalworking Technology (814) 269-2420

The National Center for Excellence in Metalworking Technology (NCEMT) is located in Johnstown, Pennsylvania and is operated by Concurrent Technologies Corporation (CTC), a subsidiary of the University of Pittsburgh Trust. In support of the NCEMT mission, CTC's primary focus includes working with government and industry to develop improved manufacturing technologies including

advanced methods, materials, and processes, and transferring those technologies into industrial applications. CTC maintains capabilities in discrete part design, computerized process analysis and modeling, environmentally compliant manufacturing processes, and the application of advanced information science technologies to product and process integration.

Center of Excellence for Composites Manufacturing Technology (414) 947-8900

The Center of Excellence for Composites Manufacturing Technology (CECMT), a national resource, is located in Kenosha, Wisconsin. Established as a cooperative effort between government and industry to develop and disseminate this technology, CECMT ensures that robust processes and products using new composites are available to manufacturers. CECMT is operated by the Great Lakes Composites Consortium. It represents a collaborative approach to provide effective advanced composites technology that can be introduced into industrial processes in a timely manner. Fostering manufacturing capabilities for composites manufacturing will enable the U.S. to achieve worldwide prominence in this critical technology.

Navy Joining Center (614) 486-9423

The Navy Joining Center (NJC) is a Center of Excellence established to provide a national resource for the development of materials joining expertise, deployment of emerging manufacturing technologies, and dissemination of information to Navy contractors, subcontractors, Navy activities, and U.S. industry.

The NJC is located in Columbus, Ohio, and is operated by Edison Welding Institute (EWI), the nation's largest industrial consortium dedicated to materials joining. The NJC combines these resources with an assortment of facilities and demonstrated capabilities from a team of industrial and academic partners. NJC technical activities are divided into three categories - Technology Development, Technology Deployment, and Technology Transfer. Technology Development maintains a goal to complete development quickly to initiate deployment activities in a timely manner. Technology Deployment includes projects for rapid deployment teaming and commercialization of specific technologies. The Technology Transfer department works to disseminate pertinent information on past and current joining technologies both at and above the shop floor.

APPENDIX E

NEW BEST MANUFACTURING PRACTICES PROGRAM TEMPLATES

Since 1985, the BMP Program has applied the templates philosophy with well-documented benefits. Aside from the value of the templates, the templates methodology has proven successful in presenting and organizing technical information. Therefore, the BMP program is continuing this existing "knowledge" base by developing 17 new templates that complement the existing DoD 4245.7-M or Transition from Design to Production templates.

The development of these new templates was based in part on Defense Science Board studies that have identified new technologies and processes that have proven successful in the last few years. Increased benefits could be realized if these activities were made subsets of the existing, compatible templates.

Also, the BMP Survey teams have become experienced in classifying Best Practices and in technology transfer.

The Survey team members, experts in each of their individual fields, determined that data collected, while related to one or more template areas, was not entirely applicable. Therefore, if additional categories were available for Best Practices "mapping," technology transfer would be enhanced.

Finally, users of the Technical Risk Identification and Mitigation System (TRIMS) found that the program performed extremely well in tracking most key program documentation. However, additional categories – or templates – would allow the system to track all key documentation.

Based on the above identified areas, a core group of activities was identified and added to the "templates baseline." In addition, TRIMS was modified to allow individual users to add an unlimited number of user-specific categories, templates, and knowledge-based questions.

APPENDIX F

COMPLETED SURVEYS

BMP surveys have been conducted at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMPNET. Requests for copies of recent survey reports or inquiries regarding the BMPNET may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 308
College Park, MD 20740
Attn: Mr. Ernie Renner, Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
ernie@bmpcoe.org

COMPANIES SURVEYED

Litton
Guidance & Control Systems Division
Woodland Hills, CA
October 1985 and February 1991

Texas Instruments
Defense Systems & Electronics Group
Lewisville, TX
May 1986 and November 1991

Harris Corporation
Government Support Systems Division
Syosset, NY
September 1986

Control Data Corporation
Government Systems Division
(Computing Devices International)
Minneapolis, MN
December 1986 and October 1992

ITT
Avionics Division
Clifton, NJ
September 1987

UNISYS
Computer Systems Division
(Paramax)
St. Paul, MN
November 1987

Honeywell, Incorporated
Undersea Systems Division
(Alliant Tech Systems, Inc.)
Hopkins, MN
January 1986

General Dynamics
Pomona Division
Pomona, CA
August 1986

IBM Corporation
Federal Systems Division
Owego, NY
October 1986

Hughes Aircraft Company
Radar Systems Group
Los Angeles, CA
January 1987

Rockwell International Corporation
Collins Defense Communications
(Rockwell Defense Electronics
Collins Avionics and
Communications Division)
October 1987 and March 1995

Motorola
Government Electronics Group
Scottsdale, AZ
March 1988

General Dynamics
Fort Worth Division
Fort Worth, TX
May 1988

Hughes Aircraft Company
Missile Systems Group
Tucson, AZ
August 1988

Litton
Data Systems Division
Van Nuys, CA
October 1988

McDonnell-Douglas Corporation
McDonnell Aircraft Company
St. Louis, MO
January 1989

Litton
Applied Technology Division
San Jose, CA
April 1989

Standard Industries
LaMirada, CA
June 1989

Teledyne Industries Incorporated
Electronics Division
Newbury Park, CA
July 1989

Lockheed Corporation
Missile Systems Division
Sunnyvale, CA
August 1989

General Electric
Naval & Drive Turbine Systems
Fitchburg, MA
October 1989

TRICOR Systems, Incorporated
Elgin, IL
November 1989

TRW
Military Electronics and Avionics Division
San Diego, CA
March 1990

Texas Instruments
Defense Systems & Electronics Group
Dallas, TX
June 1988

Bell Helicopter
Textron, Inc.
Fort Worth, TX
October 1988

GTE
C³ Systems Sector
Needham Heights, MA
November 1988

Northrop Corporation
Aircraft Division
Hawthorne, CA
March 1989

Litton
Amecom Division
College Park, MD
June 1989

Engineered Circuit Research, Incorporated
Milpitas, CA
July 1989

Lockheed Aeronautical Systems Company
Marietta, GA
August 1989

Westinghouse
Electronic Systems Group
Baltimore, MD
September 1989

Rockwell International Corporation
Autonetics Electronics Systems
Anaheim, CA
November 1989

Hughes Aircraft Company
Ground Systems Group
Fullerton, CA
January 1990

MechTronics of Arizona, Inc.
Phoenix, AZ
April 1990

Boeing Aerospace & Electronics
Corinth, TX
May 1990

Textron Lycoming
Stratford, CT
November 1990

Naval Avionics Center
Indianapolis, IN
June 1991

Kurt Manufacturing Co.
Minneapolis, MN
July 1991

Raytheon Missile Systems Division
Andover, MA
August 1991

Tandem Computers
Cupertino, CA
January 1992

Conax Florida Corporation
St. Petersburg, FL
May 1992

Hewlett-Packard
Palo Alto Fabrication Center
Palo Alto, CA
June 1992

Digital Equipment Company
Enclosures Business
Westfield, MA and
Maynard, MA
August 1992

NASA Marshall Space Flight Center
Huntsville, AL
January 1993

Department of Energy-
Oak Ridge Facilities
Operated by Martin Marietta Energy Systems, Inc.
Oak Ridge, TN
March 1993

Technology Matrix Consortium
Traverse City, MI
August 1990

Norden Systems, Inc.
Norwalk, CT
May 1991

United Electric Controls
Watertown, MA
June 1991

MagneTek Defense Systems
Anaheim, CA
August 1991

AT&T Federal Systems Advanced
Technologies and AT&T Bell Laboratories
Greensboro, NC and Whippany, NJ
September 1991

Charleston Naval Shipyard
Charleston, SC
April 1992

Texas Instruments
Semiconductor Group
Military Products
Midland, TX
June 1992

Watervliet U.S. Army Arsenal
Watervliet, NY
July 1992

Naval Aviation Depot
Naval Air Station
Pensacola, FL
November 1992

Naval Aviation Depot
Naval Air Station
Jacksonville, FL
March 1993

McDonnell Douglas Aerospace
Huntington Beach, CA
April 1993

Crane Division
Naval Surface Warfare Center
Crane, IN and Louisville, KY
May 1993

R. J. Reynolds Tobacco Company
Winston-Salem, NC
July 1993

Hamilton Standard
Electronic Manufacturing Facility
Farmington, CT
October 1993

Harris Semiconductor
Melbourne, FL
January 1994

Naval Undersea Warfare Center
Division Keyport
Keyport, WA
May 1994

Kaiser Electronics
San Jose, CA
July 1994

Stafford County Public Schools
Stafford County, VA
July 1994

Lockheed Martin
Electronics & Missiles
Orlando, FL
April 1995

Dayton Parts, Inc.
Harrisburg, PA
June 1995

Philadelphia Naval Shipyard
Philadelphia, PA
June 1993

Crystal Gateway Marriott Hotel
Arlington, VA
August 1993

Alpha Industries, Inc
Methuen, MA
November 1993

United Defense, L.P.
Ground Systems Division
San Jose, CA
March 1994

Mason & Hanger
Silas Mason Co., Inc.
Middletown, IA
July 1994

U.S. Army
Combat Systems Test Activity
Aberdeen, MD
August 1994

Sandia National Laboratories
Albuquerque, NM
January 1995

McDonnell Douglas
Aerospace (St. Louis)
St. Louis, MO
May 1995

Wainwright Industries
St. Peters, MO
June 1995
